



First record of the crab spider *Epicadus camelinus* (O. Pickard-Cambridge, 1869) in Peru (Araneae, Thomisidae, Stephanopinae)

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Abstract

The first record of the crab spider *Epicadus camelinus* (O. Pickard-Cambridge, 1869) from Peru is presented. A single female specimen was collected in the Área de Conservación Privada Panguana in 1984 and deposited in the State Museum of Natural History Karlsruhe, Germany. The record represents a considerable range extension of approximately 800 km west of the closest known locality of the species in Brazil. The specimen and the corresponding diagnostic characters are illustrated in detail.

Keywords

Biodiversity, distribution, flower, Neotropics, pollinator, predator

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Introduction

The spider family Thomisidae currently comprises 2150 species described in 169 genera, occurring worldwide (World Spider Catalog 2020) with the exception of Antarctica (Pugh 2004; Jocqué and Dippenaar-Schoeman 2006). The family is known for its flower-dwelling species that prey on pollinators (e.g., Heiling et al. 2004; Gawryszewski et al. 2017), some of them being able to change their color and become cryptic to the human eye (Weigel 1942; Heiling et al. 2003). In the Neotropical region, a significant number of thomisid genera are in urgent need of taxonomic revision, and their distribution remains unclear (World Spider Catalog 2020). However, the taxonomy of Neotropical representatives belonging to the subfamily Stephanopinae has been intensively investigated in the last few years (e.g., Machado et al. 2015; Silva-Moreira and Machado 2016; Machado et al. 2017, 2018; Prado et al. 2018). Currently, the genus *Epicadus* Simon, 1895 consists of eleven representatives,

which are characterized by large opisthosomal projections and an elevated thoracic region (for a full diagnosis, see Machado et al. 2018). At least one species (*Epicadus heterogaster* (Guérin, 1829)) is known to reflect UV-signals, similar to some other members of the Thomisidae (Gawryszewski et al. 2017), and attract pollinators even in the complete absence of nearby flowers (Vieira et al. 2017). The genus is distributed over South and Central America and occurs in climatically very different biomes (Machado et al. 2018, Sobczak et al. 2019). Like many crab spiders, the genus shows extreme sexual size dimorphism, with males being up to four times smaller than females (e.g., Silva-Moreira and Machado 2016: fig. 16b). *Epicadus camelinus* (O. Pickard-Cambridge, 1869), a rarely recorded species, is known from Brazil and Bolivia (Machado et al. 2018). During a survey of Neotropical crab spider material in the collection of the State Museum of Natural History Karlsruhe, I found an adult

female of *E. camelinus* collected in 1984 in Peru. This specimen is a new record for the country and represents a considerable westward extension of the known range. The aim of this paper is to illustrate this new record, compile all known localities, and present supplemental data on the morphology of *E. camelinus*.

Methods

The specimen was collected in 1984 by Ludwig Beck, former head of the Zoology Department of the State Museum of Natural History Karlsruhe (SMNK), during a field survey of an area belonging to the biological research station Panguana. Today, the area along with its research station is a private conservation reserve (Área de Conservación Privada Panguana; ACP Panguana) and maintained by a non-profit trust (Panguana Stiftung 2020). Formerly, the specimen was determined as “*Onocolus* sp.”. The epigyne was carefully removed with a needle and tweezers and placed in lactic acid for 24 h before examination. All photographs were made using Automontage® software (Syncroscopy, Cambridge, UK) and a Leica DFC 495 digital camera, connected to a Leica Z6 APO microscope (Leica Microsystems, Wetzlar, Germany). All measurements are in millimeters (mm). The map was created using SimpleMappr (Shorthouse 2010). Drawings were made in Adobe Photoshop® CS2 based on photographs and direct comparison under the microscope.

Results

The single female of *Epicadus camelinus* (O. Pickard-Cambridge, 1869) (Figs 1, 2), deposited in the collection of the State Museum of Natural History Karlsruhe, represents the first record of this species from Peru (Fig. 3).

New record. PERU • 1 ♀; Huánuco, Puerto Inca, Área de Conservación Privada Panguana; $-09.61, -074.93$; ca 230 m a.s.l.; Oct. 1984; Ludwig Beck leg.; collected by hand; SMNK-ARA 11007

Identification. The specimen was determined based on the diagnosis and description in Machado et al. (2018). The following measurements were taken: prosoma length 3.9 mm, prosoma width 3.8 mm, opisthosoma length 4.9 mm, total body length 8.75 mm. Although the specimen shows a slightly higher total body and opisthosoma length, the measurements are very close to those given in Machado et al. (2018). *Epicadus camelinus* is similar to *E. trituberculatus* (Taczanowski, 1872), but can be differentiated based on the presence of large brown stains on the prosoma and femur I, as well as a v-shaped pattern on the distal part of the patella I (Fig. 1), which are present in the specimen even after 36 years of preservation. Additionally, the highly contrasting pattern on tibia II (Fig. 1B) is a further trait that can be used, in combination with other characteristics, to separate both species. The basal part of this leg segment in

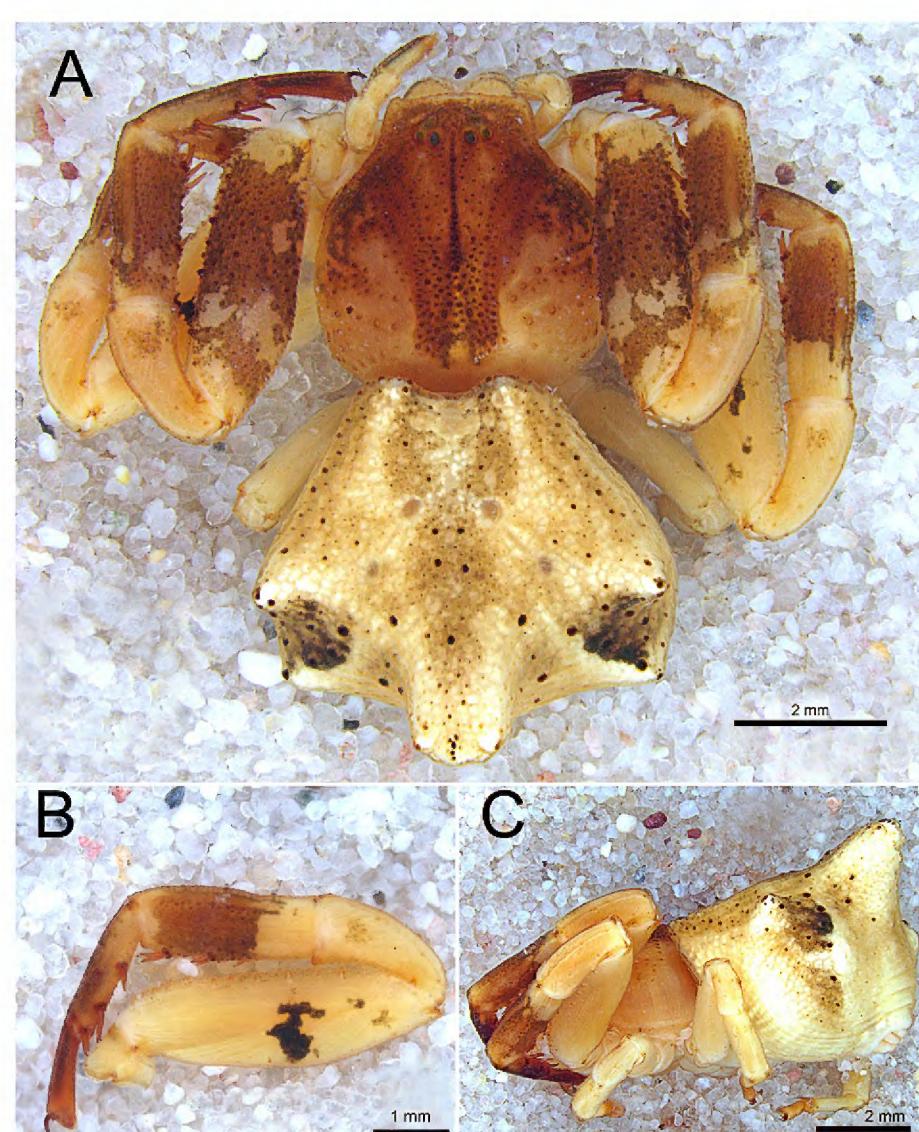


Figure 1. *Epicadus camelinus*, female (SMNK-ARA 11007). **A.** Habitus, dorsal **B.** Right Leg II, prolateral **C.** Habitus, lateral.

E. camelinus is yellowish, while the middle and distal part is contrastingly dark brown (see also Machado et al. 2018: fig. 16D for the coloration in a living specimen). This pattern is not visible in any illustration of *E. trituberculatus* by Machado et al. (2018) or Sobczak et al. (2019). The epigyne and vulva correspond well with the description by Machado et al. (2018). The epigyne (Fig. 2A, B) shows an incomplete median septum and parallel as well as relatively straight lateral folds. The copulatory openings (CO) are completely exposed and not covered. An interpretation of the highly complicated duct system within the spermathecae is given in Figure 2D. After the copulatory ducts enter the spermathecae on the ventral side, the inner progression of the duct leads to a larger chamber that finally leads to the fertilization duct. An additional, coiled, and more easily visible structure spirally encircles parts of the inner chamber as well as the progression of the copulatory ducts. Its function remains unknown.

Discussion

Epicadus camelinus is known from only four localities in Bolivia and Brazil, not including the undefined type locality in the Amazon forest (Machado et al. 2018). The closest record to the new locality in Peru, the westernmost in the known distribution, is a single female collected near Senador Guiomard (state of Acre) in Brazil. The linear distance between Senador Guiomard and the ACP Panguana is approximately 800 km. The ACP Panguana consists mainly of primary tropical lowland rainforest in the Amazon biome (Panguana Stiftung 2020).

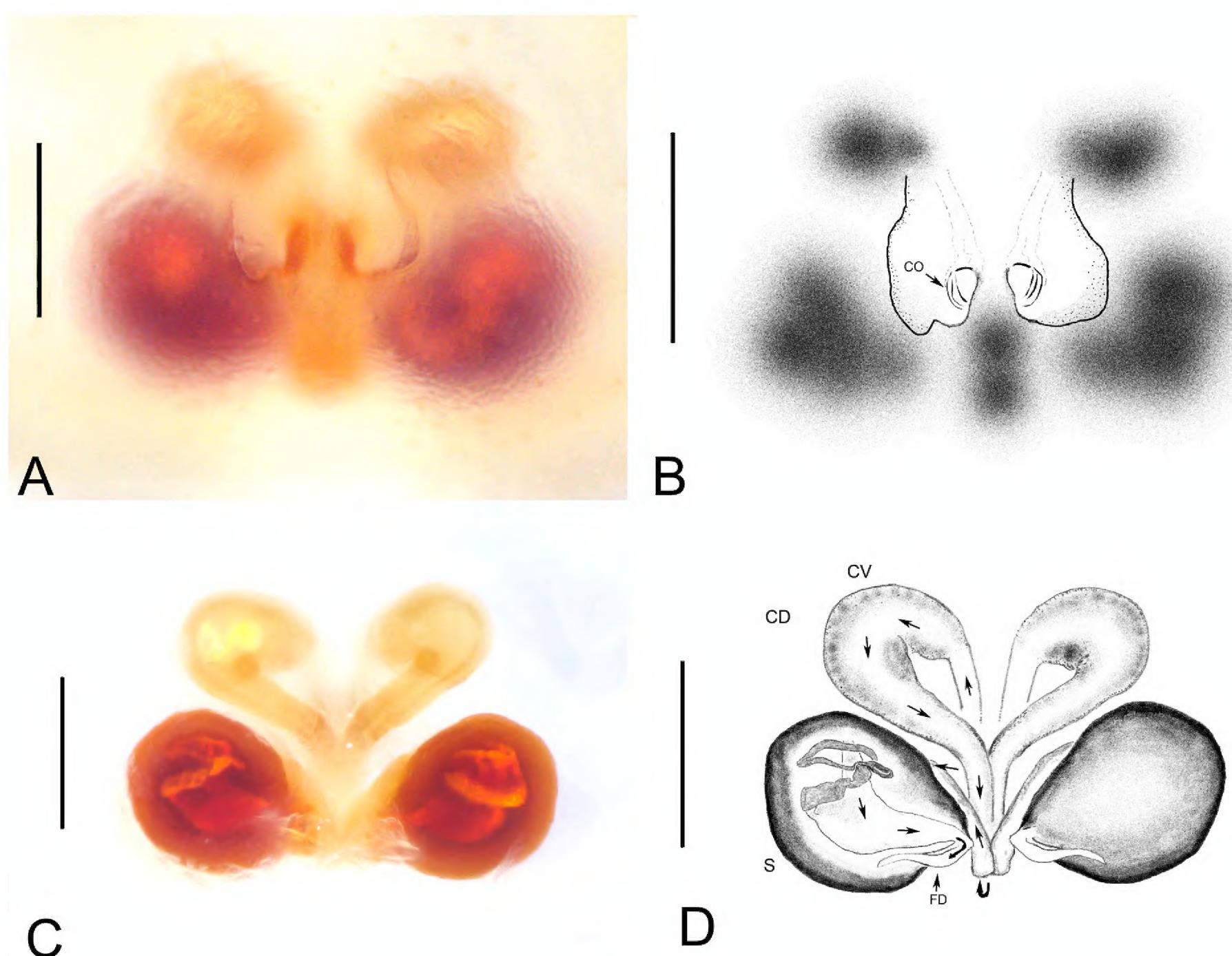


Figure 2. *Epicadus camelinus*, female (SMNK-ARA 11007). **A.** Dissected epigyne, photograph **B.** Dissected epigyne, drawing. **C.** Vulva dorsal, photograph. **D.** Vulva dorsal, drawing. Abbreviations (terminology after Silva-Moreira and Machado 2016): CD = copulatory duct, CO = copulatory openings, CV = anterior curve of the copulatory duct, FD = fertilization duct, S = spermatheca. Arrows (D) indicate pathway from CO to FD. Scale bars = 0.2 mm.

In Brazil, a record of the species is known from Foz do Iguaçu, southern Brazil, in the Mata Atlântica biome (Refúgio Biológico Bela Vista; Machado et al. 2018). That region is characterized by a humid subtropical climate (Aparecido et al. 2016). *Epicadus trituberculatus*, a widespread species that is morphologically similar to *E. camelinus*, has been observed in forested semi-arid regions of northeastern Brazil as well as in all other Brazilian biomes (Sobczak et al. 2019). Based on the currently known distribution of both species, it is speculated that *E. camelinus* is restricted to forested regions with high precipitation, while *E. trituberculatus* has a much wider climatic niche. Although compelling, this hypothesis still needs further investigation.

Differences in female copulatory organs are very subtle among *Epicadus* species and therefore it is necessary to include other morphological traits in determination efforts, such as the prosoma or leg pattern. The inner structure and function of the spermathecae, nonetheless, still seem to present important diagnostic characteristics that need further investigation and might provide new traits for determination of damaged or completely bleached specimens in museum collections. In *E. camelinus*, the inner spermathecae structure differs much from *E. rubripes* Mello-Leitão, 1924, the only other species of

the genus for which those structures are known (Silva-Moreira and Machado 2016, Fig. 8).

The male of *E. camelinus* is still unknown. The spider collection of the SMNK contains a male specimen of *Epicadus* from the ACP Panguana (SMNK-ARA 11004) collected in 1985. In several cases, the highly similar males of *Epicadus* can only be determined based on the position and emergence of the embolus (Machado et al. 2018). Unfortunately, both palps of the SMNK specimen are completely inflated and slightly damaged, which prohibits an identification. Based on the habitus and color pattern, it is very similar to *E. taczanowskii* (Roewer, 1951), *E. trituberculatus* or *E. dimidiaster* Machado, Teixeira & Lise, 2018 (see Machado et al. 2018), all of which represent widespread species potentially occurring in the ACP Panguana. Such uncertainties on morphological identification of males highlight the potential of COI (barcode)-sequencing to determine the male of *E. camelinus* (e.g., Magalhaes et al. 2017).

Further taxonomic, biogeographical, and ecological research is urgently needed in this genus. The remarkable morphology of many species probably reflects particular, yet unknown adaptions to their habitats (see also Vieira et al. 2017), which makes them highly interesting for ecological and behavioral experiments. Many

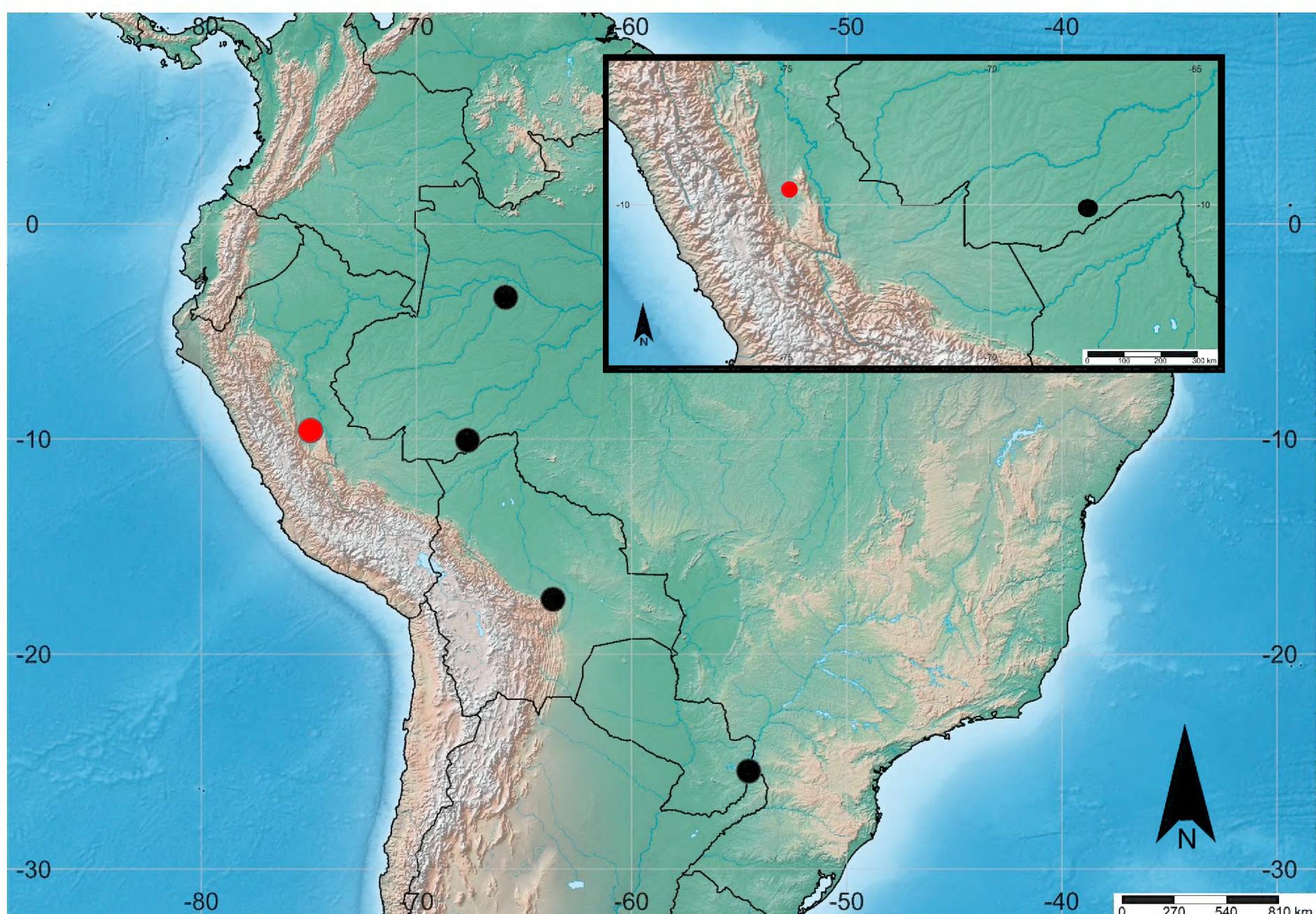


Figure 3. Records of *Epicadus camelinus* in South America. Black circles = known records (Machado et al. 2018); red circle = new record from Peru. Inset shows the new record of the species from Peru and the closest locality in Brazil (Senador Guiomard, state of Acre).

recently described or revised species of the genus are known from widely separated regions and/or only a few localities (e.g., *E. granulatus* Machado, Teixeira & Lise, 2018; Machado et al. 2018). Future collection activities and museum surveys will most probably reveal new records of various *Epicadus* species in other regions of the Neotropics.

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